

## Influenza pandemic planning

Nancy J. Cox<sup>a,\*</sup>, Susan E. Tamblyn<sup>b</sup>, Theresa Tam<sup>c</sup>

<sup>a</sup> Influenza Branch, Centers for Disease Control and Prevention, 1600 Clifton Road, NE, Atlanta, GA 30333, USA

<sup>b</sup> Division of Immunization and Respiratory Diseases, Perth District Health Unit, Ottawa, Ont., Canada

<sup>c</sup> Health Canada, Stratford, Ont., Canada

### Abstract

Periodically, novel influenza viruses emerge and spread rapidly through susceptible populations, resulting in worldwide epidemics or pandemics. Three pandemics occurred in the 20th century. The first and most devastating of these, the “Spanish Flu” (A/H1N1) pandemic of 1918–1919, is estimated to have resulted in 20–50 million or more deaths worldwide, with unusually high mortality among young adults [C.W. Potter, Chronicle of influenza pandemics, in: K.G. Nicholson, R.G. Webster, A.J. Hay (Eds.), Textbook of Influenza, Blackwell Science, Oxford, 1998, p. 3]. Mortality associated with the 1957 “Asian Flu” (A/H2N2) and the 1968 “Hong Kong Flu” (A/H3N2) pandemics was less severe, with the highest excess mortality in the elderly and persons with chronic diseases [J. Infect. Dis. 178 (1998) 53]. However, considerable morbidity, social disruption and economic loss occurred during both of these pandemics [J. Infect. Dis. 176 (Suppl. 1) (1997) S4]. It is reasonable to assume that future influenza pandemics will occur, given historical evidence and current understanding of the biology, ecology, and epidemiology of influenza. Influenza viruses are impossible to eradicate, as there is a large reservoir of all subtypes of influenza A viruses in wild aquatic birds. In agricultural-based communities with high human population density such as are found in China, conditions exist for the emergence and spread of pandemic viruses. It is also impossible to predict when the next pandemic will occur. Moreover, the severity of illness is also unpredictable, so contingency plans must be put in place now during the inter-pandemic period. These plans must be flexible enough to respond to different levels of disease.

Published by Elsevier Science Ltd.

**Keywords:** Pandemic planning; Influenza pandemics; Influenza surveillance

### Key messages

- Influenza pandemic preparedness planning is based on the 1999 WHO guidelines, and most national plans have adopted WHO’s phased approach to responding to a pandemic threat.
- Pandemic preparedness planning can be usefully linked to response planning for other public health emergencies, including bioterrorism threats.
- Regional and international coordination of responses to an influenza pandemic will be essential but planning how to do this will be very difficult.
- Fewer than 30 countries have developed pandemic preparedness plans and only a handful have begun to translate them into policy decisions and concrete actions.
- The best defense against the next pandemic is to strengthen global vaccination programs in response to seasonal epidemics of influenza.

### 1. Introduction

An influenza pandemic begins with an abrupt and major change in the surface proteins, hemagglutinin and neuraminidase, of the influenza A virus. This change, termed “antigenic shift”, gives rise to a virus that is radically different from those circulating in human populations during preceding years. A pandemic is considered likely if the novel virus is readily transmissible from person to person and causes disease and if there are large populations worldwide that lack immunity to the virus. Pandemic viruses are thought to arise in several ways: the exchange (re-assortment) of gene segments between human and avian or swine influenza viruses; direct transmission of influenza viruses from birds, swine or other animals to humans; and re-cycling of human virus subtypes that circulated in human populations in a previous era.

In 1997, a highly pathogenic avian H5N1 influenza virus was transmitted directly from live commercial poultry to humans in Hong Kong. Six of 18 people who were hospitalized died. Mass slaughter of the poultry in the live bird markets was carried out to remove the source of infection and additional human cases were not reported [1]. However,

\* Corresponding author. Tel.: +1-404-639-3591; fax: +1-404-639-2334.  
E-mail address: ncox@cdc.gov (N.J. Cox).

highly pathogenic H5N1 influenza viruses have been isolated from poultry in Hong Kong on several subsequent occasions and studies show that the precursors of the lethal 1997 H5N1 virus continue to circulate in Hong Kong, posing an ongoing pandemic threat [2]. In 1999, two human infections with avian influenza H9N2 viruses were reported in Hong Kong [3]; subsequently, five additional human H9N2 infections were reported in southern China and a relatively high seroprevalence rate for H9 antibody was documented among Hong Kong poultry workers. These events highlight the pandemic threat posed by avian influenza viruses. They emphasize the need for advance planning to ensure an adequate response to a health emergency that will be unpredictable, complex and cause considerable public alarm.

## 2. Pandemic readiness

Once a pandemic begins it will be too late to accomplish the many key activities required to minimize its impact. Therefore, preparatory activities must start well in advance. Planning for pandemics will enhance the capacity to respond to other large-scale health emergencies, including a bioterrorism event, which require mass access to preventive and therapeutic measures. Strong national plans will also help calm public fears.

The impact of pandemic influenza is likely to be far greater, by orders of magnitude, than most bioterrorism events. Unlike most other health emergencies, influenza pandemics occur in several waves and may last a year or two. Consequently, response efforts must be sustained for a prolonged period. Preparedness and the response to both influenza pandemics and bioterrorism events require close collaboration between public health and emergency responders, and should build on existing emergency response frameworks. Exercising pandemic plans will assist bioterrorism preparedness, especially when they include immunization programs (e.g. smallpox, anthrax). In addition, investments in pandemic preparedness will have an immediate impact on the prevention and control of annual influenza epidemics.

### 2.1. International planning

Given the global nature of influenza pandemics, close international collaboration is required to develop sound prevention and control strategies. In 1999, the World Health Organization (WHO) published its influenza pandemic preparedness plan [4]. This plan defines WHO's role during a pandemic and provides guidelines for national and regional pandemic planning. The plan is scheduled for updating in 2003. The preparedness levels defined in the WHO plan (Table 1) have been incorporated into many national plans as a consistent way to phase the response. More recently, WHO published its global agenda on influenza surveillance and control [5]. This document provides key recommendations on national and global pandemic preparedness.

Table 1  
WHO response phases

|                  |                                       |
|------------------|---------------------------------------|
| Phase 0          | Interpandemic activities              |
| Phase 0, level 1 | New strain in human case              |
| Phase 0, level 2 | Human infection confirmed             |
| Phase 0, level 3 | Human transmission confirmed          |
| Phase 1          | Confirmed onset of pandemic           |
| Phase 2          | Regional and multi-regional epidemics |
| Phase 3          | End of first pandemic wave            |
| Phase 4          | Second or later waves of the pandemic |
| Phase 5          | End of the pandemic (back to phase 0) |

### 2.2. National planning

Countries should begin by establishing a National Pandemic Planning Committee. The committee must have a coordinator and include individuals with technical expertise on influenza; without such a structure it will be difficult to proceed. The next step involves setting clearly defined national goals and priorities for the pandemic response. This requires consideration of logistical, ethical, moral, cultural, legal and political issues related to the allocation of scarce resources. Examples of possible goals include reduction of death, reduction of serious illness, limiting social disruption, maintaining health care systems and limiting economic losses. However, it will not be possible for even the richest country to meet all of these goals. Both the WHO pandemic preparedness plan [4] and the draft WHO guidelines on the use of vaccines and antivirals during influenza pandemics [6] provide additional considerations for this goal-setting process.

During the current inter-pandemic phase, plans must focus on building routine influenza prevention and control activities, increasing vaccine coverage of high-risk groups, enhancing surveillance efforts and pursuing research that will strengthen the pandemic response. National pandemic plans typically include sections on surveillance, vaccines and antiviral agents, communications, emergency response and research. Linking pandemic planning to similar planning exercises for other public health emergencies, including bioterrorism, and creating generic components whenever possible (e.g. a mass vaccination plan) represent wise use of scarce resources.

Enhancing global surveillance for influenza is crucial because an early warning of an impending pandemic might save thousands of lives. Furthermore, it is critically important that candidate pandemic influenza vaccine seeds be developed now for the influenza A subtypes that pose a pandemic threat. Pilot experimental vaccine lots should be produced and tested for immunogenicity and safety in order to develop a better understanding of the human immune response to hemagglutinin and neuraminidase subtypes that could pose a pandemic threat. Influenza pandemic plans must also address the probable shortage of vaccines and antiviral agents, particularly during the early stages of a pandemic. Antivirals will be the only preventive intervention

available before vaccine can be produced. Thus, it is important for countries where influenza antivirals are approved for use to grapple with the difficult issues of their cost and limited supply. A very practical consequence of these limited supplies is that each country will have to identify the population groups that should receive the first doses of vaccine and antivirals once they become available. Successful implementation of a pandemic response will require a clear chain of command and a strategy and structure for effective communications at both the national and local levels. A country's planning is not complete until its plans are put in place at the local level where the actual response will take place. Finally, plans at all levels must be updated and exercised periodically.

### 2.3. Regional planning

Influenza surveillance and strategies for vaccine and antivirals can benefit from discussions and coordination with neighboring jurisdictions. One example of regional planning is that of the European Commission, which has met with influenza experts and undertaken the task of writing a European preparedness plan [7]. The main purpose of the commission's plan is to achieve a coordinated response by the European Community in the event of a pandemic. The plan addresses key components of the European response, clarifies the roles of responsible parties and describes the community's response within the international context. The European pandemic planning process is an excellent example of the synergies that can be gained through a regional approach to pandemic planning.

### 3. Conclusions

A future influenza pandemic is highly likely if not inevitable. During the past 5 years, considerable progress toward pandemic preparedness has been made in the

Americas, Europe, Asia and Oceania. Several countries have produced valuable frameworks, models, guidelines, and action plans that can be used by other countries that are just beginning their planning efforts. In spite of this progress, however, the world remains ill prepared for the next pandemic. Fewer than 30 countries have developed pandemic plans and only a handful have begun to translate their plans into policy decisions and concrete actions. Many obstacles to influenza pandemic planning remain, including a lack of appreciation of the pandemic threat, lack of resources and difficulties in gaining political and financial commitment. The best defense against the next pandemic will be to strengthen the global capacity to respond to yearly epidemics of influenza. By building this capacity we will not only be better prepared for the next pandemic, we will also save thousands of lives before it arrives.

### References

- [1] Shortridge KF. Poultry and the influenza H5N1 outbreak in Hong Kong: abridged chronology and virus isolation. *Vaccine* 1999;17(1):S26–9.
- [2] Webster RG, Guan Y, Peiris M. Characterization of H5N1 influenza viruses that continue to circulate in geese in southeastern China. *J Virol* 2002;76:118–26.
- [3] Uyeki TM, Chong YH, Katz JM, et al. Lack of evidence for human-to-human transmission of avian influenza A (H9N2) viruses in Hong Kong, China, 1999. *Emerg Infect Dis* 2002;8:154–9.
- [4] World Health Organization. Influenza pandemic preparedness plan—the role of WHO and guidelines for national and regional planning. Geneva: World Health Organization; 1999 (<http://www.who.int/emc/diseases/flu/>).
- [5] World Health Organization. Global agenda on influenza surveillance and control, part II. *Wkly Epidemiol Rec* 2002;23:191–5.
- [6] World Health Organization. Draft WHO guidelines on the use of vaccines and antivirals during influenza pandemics. *Wkly Epidemiol Rec* 2002;77:394–404.
- [7] Paget J, Aguilera JF. Influenza pandemic planning in Europe. *Eurosurveillance* 2001;6:136–40 (<http://www.eurosurveillance.org/em/v06n09/0609-222.asp>).